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Structured Systems Analysis and Design (SSADM) Approach in Web-Based Biometric Attendance Systems: A Study at BASARNAS Lampung

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Abstract *- This study aims to design a Software Requirements Specification (SRS) for a Web-Based Fingerprint Attendance Information System at the National Search and Rescue Agency (BASARNAS) Lampung, intended to replace the inefficient manual attendance data management process. Utilizing the Structured Systems Analysis and Design Method (SSADM), this research encompasses the stages of feasibility study, requirements analysis, and system design. Data collection was conducted through structured interviews, questionnaires, and documentation review to assess the current system and determine user needs. The results indicate that the proposed system is capable of improving the efficiency, accuracy, and speed of attendance data management, while also minimizing the risk of data loss and human error. Furthermore, user responses suggest strong support and readiness for the implementation of the new system. This system is not only relevant in addressing administrative challenges but also supports the modernization and effectiveness of human resource management at BASARNAS Lampung. The resulting SRS is expected to serve as a comprehensive reference for future system development and implementation.*

Keywords: *Attendance Information System; Fingerprint; Web-Based System; SSADM; BASARNAS Lampung.*

1. INTRODUCTION

The National Search and Rescue Agency (BASARNAS) Lampung already employs fingerprint-based attendance to curb fraud, yet it still processes the resulting data in spreadsheets, an approach that slows daily operations, hinders historical tracking, and increases the risk of transcription errors [1]. As personnel numbers grow and reporting demands rise, these manual procedures become a bottleneck, underscoring the urgency of a modern, web-based attendance information system that fully supports Indonesia's push for digital public administration.

A rigorous system analysis will guide this initiative by aligning design choices with real-world conditions and producing a Software Requirements Specification (SRS) that steers each development phase. Through careful requirement elicitation and stakeholder interviews, analysts can identify pain points, such as delayed overtime approvals or inaccurate absence figures, and translate them into measurable system objectives [2]. The envisioned platform will automate routine calculations, generate real-time dashboards, and provide secure, role-based access to HR, finance, and management teams, thereby accelerating reports, simplifying data retrieval, and strengthening HR oversight across the agency.

Attendance, defined as an organizational measure of discipline, benefits significantly from biometric technology. Rooted in the Greek terms bio (life) and metrics (measure), biometric authenticates users by what they know, possess, or inherently are. Among biometric options, fingerprints stand out because every individual's pattern is unique and extremely difficult to replicate [3]. When combined with Internet-of-Things (IoT) connectivity, fingerprint devices allow employees to check in over Wi-Fi or mobile hotspots, making attendance possible from remote command posts and disaster-response sites. This mobility ensures that BASARNAS teams remain accountable even during field operations [4].

To build a reliable solution, BASARNAS Lampung can adopt the Structured Systems Analysis and Design Method (SSADM). Originating in the UK during the 1980s, SSADM emphasizes meticulous documentation

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and data modeling, yielding deeper insight than approaches such as SSM or OOAD [5]. Its staged workflow, covering feasibility, requirements analysis, logical data and process modeling, and physical design, keeps the project traceable, audit-ready, and consistent with internal policies. Each stage produces deliverable that incrementally refine scope and reduce technical uncertainty before coding begins [6].

Supporting models further clarify both logic and data. Flowcharts visualize program steps, expose potential error branches, and aid in early debugging [7]. Unified Modeling Language (UML) diagrams, particularly use-case, activity, and class diagrams, depict user interactions, end-to-end workflows, and system structures so that developers, testers, and non-technical stakeholders share a common vision [8]. At the database layer, an Entity-Relationship Diagram (ERD) maps out tables and relationships, helping designers enforce data integrity rules and optimize query performance from the outset [9].

The SRS remains the cornerstone artifact: it records functional and non-functional requirements in detail, establishes performance benchmarks, and serves as the baseline for acceptance testing and future maintenance [10]. Because every requirement in the SRS is traceable to stakeholder needs, it also becomes the main vehicle for formal validation and sign-off, ensuring that the delivered system matches BASARNAS Lampung's operational realities [10].

By marrying fingerprint biometric with IoT connectivity, following SSADM's disciplined road map, and underpinned by comprehensive modeling and an SRS, the proposed web-based attendance system promises not only faster and more accurate record-keeping but also stronger accountability, better audit trails, and seamless integration with the agency's broader digital-transformation agenda [11].

2. RESEARCH METHODOLOGY

This study adopts the Structured Systems Analysis and Design Method (SSADM) to analyze and design a Web-Based Fingerprint Attendance Information System at BASARNAS Lampung. SSADM was chosen for its systematic approach in managing each phase of system development, from feasibility study to physical design, ensuring that the resulting system meets user needs and operates effectively [6]. The flow of SSADM method is depicted in Figure 1.

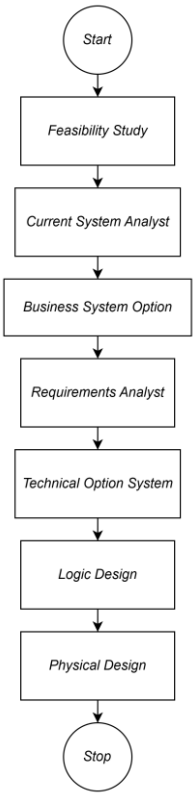


Figure 1. SSADM flowchart.

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2.1. Feasibility Study

A feasibility study is used to assess whether to proceed with or halt the development of a system project, typically covering technical, economic, and operational feasibility [12]. At this stage, the author conducts a preliminary evaluation to determine the feasibility of the proposed web-based attendance information system at the National Search and Rescue Agency (BASARNAS) Lampung. The assessment includes cost-benefit analysis and evaluation of the system's technical, operational, and economic aspects. The process involves structured interviews, financial data collection, cost-benefit analysis, and identification of technical and operational risks [13].

2.2. Current System Analysis

The current system analysis stage involves examining and documenting the existing system's procedures, data flows, and stakeholder interactions to identify inefficiencies and bottlenecks. This stage provides a foundation for designing an improved system by highlighting gaps between current practices and user needs [14].

2.3. Business System Analysis

In SSADM, the Business System Option (BSO) phase explores and compares multiple conceptual solutions to the problems identified in the current system. Each option is evaluated based on feasibility, cost, benefit, and alignment with organizational objectives. This ensures that the selected solution fits within the operational and strategic framework of the organization [15].

2.4. Requirement System Analysis

This phase focuses on eliciting, analyzing, and documenting the system's functional and non-functional requirements. Functional requirements include capabilities such as automatic check-in/check-out, report generation, and integration with employee records. Non-functional requirements include performance, security, and usability. The outcome is a detailed Software Requirements Specification (SRS), serving as a contractual basis for further design and validation [16].

2.5. Technical System Option

This phase identifies and compares technical implementations that can fulfill the business and user requirements. Considerations include software architecture, database technology, and platform compatibility. The chosen option balances technical feasibility, future scalability, and cost-effectiveness [17].

2.6. Logical Design

The logical design stage translates requirements into abstract models, including data structures, input/output specifications, and process flows. It defines how data moves through the system and how it is processed logically without being tied to physical implementation details [18].

2.7. Physical Design

In the physical design stage, logical models are translated into concrete system components, such as hardware configurations, network infrastructure, and storage mechanisms. It ensures the designed solution is ready for real-world deployment, with attention to reliability, speed, and integration with biometric attendance devices [19].

3. RESULTS AND DISCUSSION

This section presents the results of the system development process for the web-based fingerprint attendance information system, following the Structured Systems Analysis and Design Method (SSADM). It covers each stage of the methodology, including feasibility study, current system analysis, business system options, requirements analysis, technical system options, logical design, and physical design.

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3.1. Result of Feasibility Study

The feasibility study was conducted through structured interviews, review of financial documents, cost-benefit analyses, and identification of technical and operational risks [14]. The institution issued an official statement endorsing the implementation of a web-based fingerprint attendance system following the study's submission.

From an economic perspective, the institution demonstrated readiness to allocate a budget for hardware, software, and ongoing maintenance, guided by market price benchmarks and procurement planning. The technical evaluation revealed that the existing attendance system, based on spreadsheets and manual processing, is functional but lacks automation, integration, and data validation mechanisms, leading to inefficiencies and higher potential for human error. The proposed system introduces automated calculations, secure data storage, and encrypted access controls to improve reliability and reduce fraud [16].

On the organizational side, the system is anticipated to enhance employee discipline, reduce administrative workloads, and enable real-time data monitoring. These benefits are aligned with the agency's broader agenda to modernize administrative operations and transition toward digital governance practices [20].

The results of this study affirm that the proposed system is feasible from economic, technical, and organizational standpoints and provide a strong foundation to move forward with the development process.

3.2. Result of Current System Analysis

The analysis of the current attendance system was conducted using a combination of direct observation, semi-structured interviews, document analysis, and business process modeling techniques [21]. The investigation uncovered several shortcomings in the existing fingerprint-based system, primarily related to manual data handling. Most processes, including data export from the fingerprint device, data cleaning, report compilation, and employee absence tracking, are still carried out manually using spreadsheets.

This reliance on manual workflows leads to increased workload, higher risk of human error, and frequent delays in generating accurate attendance reports [22]. Moreover, there is no centralized database or web interface to facilitate real-time access, making it difficult for HR and management to monitor employee attendance proactively.

To understand the system's deficiencies more precisely, a gap analysis was conducted. This comparison outlined discrepancies between the capabilities of the current system and the functional expectations for the proposed web-based fingerprint attendance platform. The analysis highlighted critical areas such as automation, data security, integration with employee records, and dashboard-based reporting. These gaps underscore the urgency for transitioning to a more efficient, web-enabled solution that aligns with BASARNAS Lampung's operational and administrative modernization goals [23]. The results of this analysis are presented in the following Table 1.

Table 1. Result of current system analysis.

Aspect	Current Condition	New System Requirement	Identified Gap
Fingerprint Accuracy	Sensor often fails	Accurate and reliable	Needs better sensor and algorithm
Data Collection	Manual via flash drive	Real-time automatic sync	Requires integration and network
Data Access	Limited to staff PC	Web access on various devices	Needs secure web interface
Reports	Manual and slow	Automatic and real-time	Needs report automation
Leave Management	Manual submission	Integrated with attendance	Needs digital leave module
Data Security	Weak access control	Authentication and encryption	Needs stronger security
Maintenance	Manual, limited IT support	Easy and supported maintenance	Needs training and planning

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Aspect	Current Condition	New System Requirement	Identified Gap
Efficiency	Many manual steps	Process automation	Needs workflow simplification
Change Resistance	Staff reluctant to switch	Training and adaptation support	Needs change management
System Flexibility	Hard to modify or scale	Scalable and flexible	Needs modular architecture

3.3. Result of Business System Option

At this stage, a series of brainstorming sessions were held with key stakeholders to identify and assess possible solutions to improve the existing attendance system. Conceptual models were developed for each proposed alternative and evaluated based on multiple factors such as cost, technical feasibility, operational impact, and alignment with organizational needs [24]. Three system options were considered: (1) developing a new custom-built system, (2) adopting an existing open-source system, and (3) purchasing a commercial off-the-shelf (COTS) solution.

A multi-criteria decision-making approach was employed using a Likert scale ranging from 1 to 5, and scores were assigned by three expert informants from the technical and operational units. The evaluation matrix used weighted criteria to quantify the strengths and weaknesses of each alternative. As shown in Table 2, the new system development option scored the highest, with a total of 81.65, compared to 76.00 for the open-source option and 62.32 for the commercial solution.

These findings suggest that developing a new system is the most appropriate option for BASARNAS Lampung, offering better adaptability, problem-solving capability, and long-term value. This option also aligns well with the institution's goal of tailoring functionality to its unique operational workflows, especially in the context of fingerprint-based attendance integrated with web technologies. As a result, the custom development path was selected as the preferred strategy for system implementation.

3.4. Result of Requirement Analysis

The requirements analysis phase was conducted using a combination of qualitative and structured approaches. In-depth interviews were carried out with key stakeholders to elicit user expectations, while user stories were developed to represent typical system interactions and operational scenarios. These stories served as a basis for identifying both functional and non-functional requirements, ensuring that the system design would align with real-world workflows and organizational objectives [25].

The analysis yielded a comprehensive list of system requirements, which were categorized into two groups: functional requirements and non-functional requirements. Functional requirements define the specific system capabilities needed to support core activities such as user authentication, fingerprint data processing, attendance recording, report generation, and role-based access control. Non-functional requirements, on the other hand, address quality attributes of the system, including performance, availability, security, and ease of use [26].

This classification forms the foundation for subsequent stages of design and development, ensuring that the proposed web-based fingerprint attendance system at BASARNAS Lampung not only delivers expected functionality but also meets critical performance and security standards. The following Table 2 summarizes the key functional and non-functional requirements identified during the analysis.

Table 2. Functional and non-functional requirement.

Code	Requirement Name	Requirement Description
F01	Real-Time Attendance Monitoring	Admin can monitor employee attendance in real-time.
F02	View Attendance Records	Employees can view their own attendance history.
F03	Manage Attendance Reports	Admin can generate and manage attendance reports.

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Code	Requirement Name	Requirement Description
F04	View Profile	Admin and employees can access and view their profile data.
F05	Submit Leave/Permission Request	Employees can submit leave or permission requests.
F06	Manage Leave/Permission Requests	Admin can review and approve/reject leave or permission requests.
F07	Manage SPT (Duty Assignment Letter)	Admin can create and manage duty assignment letters (SPT).
F08	View Leave/Permission Request Status	Employees can check the status of their submitted requests.
F09	Print Leave/Permission Letters	Employees can download and print approved leave/permission letters.
F10	Submit Manual Attendance	Employees can submit manual attendance if needed.
F11	View Manual Attendance Submission Status	Employees can check the status of manual attendance submissions.
F12	Manage Manual Attendance	Admin can verify and update manual attendance submissions.
NF01	User Authentication	System must support secure user login and authentication.
NF02	Security	System must protect data through access control and encryption.
NF03	Performance	System should respond quickly under normal usage conditions.
NF04	Usability	Interface should be user-friendly and easy to navigate.
NF05	Reliability	System should function consistently without failures.
NF06	Scalability	System must accommodate increased users and data over time.
NF07	Compatibility	System should run smoothly across various devices and browsers.

3.5. Result of Technical System Option

The evaluation of available technologies was conducted through a combination of system security assessments and technical consultations with the internal IT team. The results revealed that although the existing attendance system has basic protection mechanisms, it still exhibits several vulnerabilities. These include exposure to unauthorized access, inadequate data protection during transmission, and the absence of safeguards to detect or prevent data manipulation. As a consequence, the technical team concluded that significant enhancements are needed to ensure data integrity, confidentiality, and overall system resilience [27].

In response to these findings, a set of mitigation strategies was proposed. For biometric data protection, it is recommended to adopt end-to-end encryption, such as AES-256, for securing both data storage and transmission. Additionally, irreversible data should be hashed using secure algorithms (e.g., SHA-256) to prevent reconstruction in the event of a breach [28].

User-level security can be reinforced through the implementation of multi-factor authentication (MFA) and role-based access control (RBAC), ensuring that system access is aligned with user responsibilities and privileges. To protect communication channels, the use of HTTPS with valid SSL/TLS certificates is mandatory. Moreover, input validation and sanitization techniques must be enforced to mitigate web-based vulnerabilities such as SQL injection and cross-site scripting (XSS) [29].

3.6. Result of Logical Design

The logical design phase involved the development of several structured modeling diagrams aimed at accurately depicting the functional behavior and data architecture of the proposed web-based fingerprint attendance system. These diagrams included flowcharts, use case diagrams, activity diagrams, entity-relationship diagrams (ERD), and class diagrams. Each model served a specific purpose in capturing system logic, visualizing user interactions, and illustrating data relationships to ensure clarity in the system's functional blueprint [30].

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Stakeholder validation sessions were held during this phase to review and refine each diagram, ensuring that the models aligned with operational workflows and addressed actual system requirements. The use case diagram outlined the roles and interactions of different actors with the system, while the activity diagram represented process sequences for key attendance-related operations. The ERD was particularly crucial in defining the structure and relationships of core entities such as users, attendance records, and system logs [31].

To maintain conciseness in this article, only selected diagrams are presented for illustrative purposes. These selected models provide an overview of the system's logical framework and served as the foundational reference for the subsequent physical design phase. The complete set of diagrams and their detailed explanations are available in the full system documentation.

3.6.1. Use Case Diagram

One of the key diagrams developed in this phase is the use case diagram, which illustrates the system's functional scope. The primary actors include the administrator and employees, each with distinct access rights and responsibilities. The administrator can manage attendance records, process leave requests, and perform data management tasks, while employees can view attendance history, submit requests, and check their approval status. Figure 2 presents the use case diagram of the system.

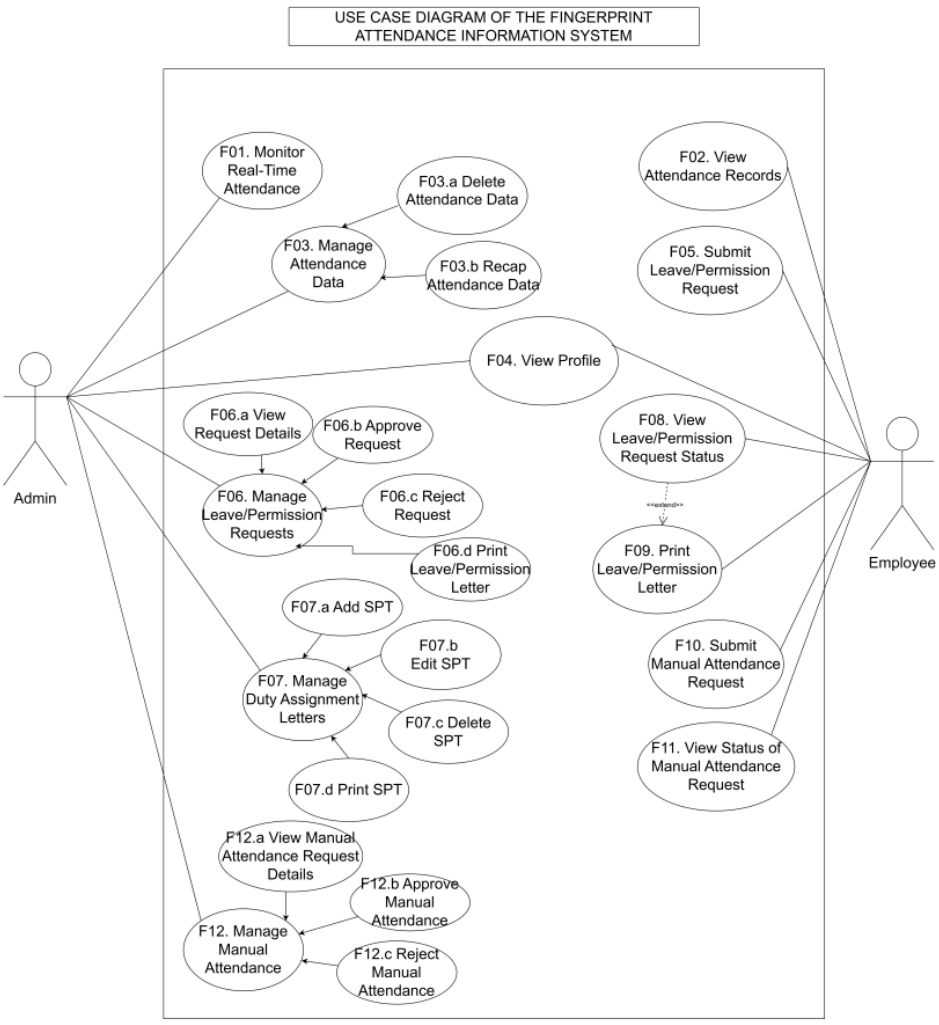


Figure 2. Use case diagram of the fingerprint attendance information system.

3.6.2. Entity-Relationship Diagram (ERD)

The Entity-Relationship Diagram (ERD) illustrates the logical data structure of the proposed web-based fingerprint attendance information system. It defines key entities, such as User, Attendance, LeaveRequest, and ManualAttendance, along with their attributes and the relationships among them. Primary and foreign

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key constraints are used to ensure referential integrity and accurately reflect real-world dependencies between data points.

Each entity was designed to capture critical operational information. For example, the Attendance entity records fingerprint scan timestamps and is linked to the User entity via a foreign key, enabling the tracking of individual attendance behavior. Similarly, LeaveRequest and ManualAttendance entities support special attendance conditions, such as leave approvals or manually inputted records, while maintaining consistency within the database structure.

This ERD plays a crucial role in the system design process as it informs the development of the physical database schema, ensuring data consistency, normalization, and support for efficient queries. Figure 3 presents a simplified version of the ERD used in the system.

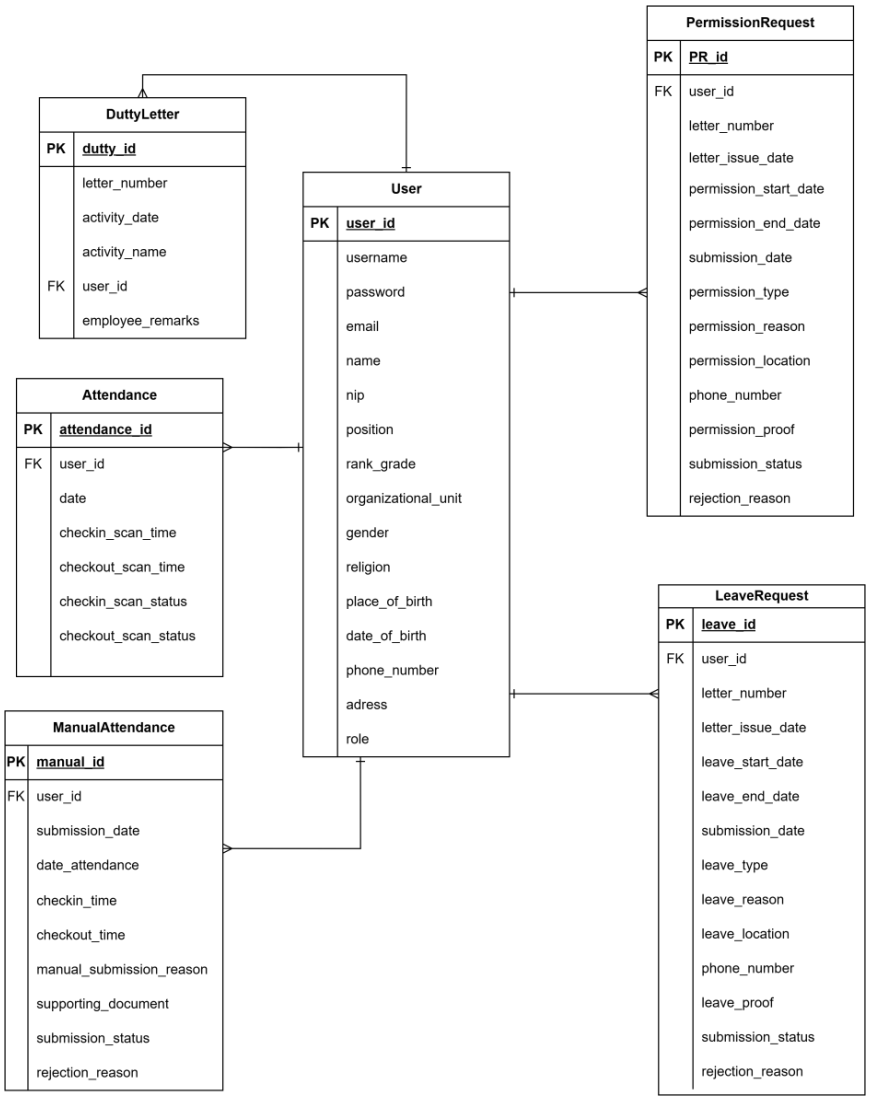


Figure 3. ERD of the fingerprint attendance information system.

The central entity is User, which stores essential user information such as user ID, name, role, and credentials. The User entity is connected to multiple data-related entities, as follows:

a. Attendance: This entity stores fingerprint-based attendance data, including check-in and check-out times. Each attendance record is linked to one user.
b. Manual_Attendance: This entity contains records of manual attendance input, serving as a backup or alternative when fingerprint data is unavailable. It also relates to one user.

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c. Leave_Request: This entity stores employee leave applications, including start date, end date, and approval status. Each leave request is submitted by a user.
d. Permission_Request: This entity represents permission letters for special cases (e.g., sick leave or sudden leave), submitted by users and stored with relevant details.
e. Task_Order (SPT): This entity records official assignment orders related to field operations or travel, linked to the respective user.

3.6.3. Class Diagram

The Class Diagram is used to model the static structure of the system from an object-oriented perspective. It illustrates the classes used in the system along with their attributes, methods, and the relationships between them. This diagram helps bridge the gap between functional modeling and object-oriented programming, ensuring that the system design can be implemented effectively in code. The class diagram includes classes such as User, DuttyLetter, ManualAttendance, and others highlighting associations such as one to many and many to one. Figure 4 presents the class diagram of the system.

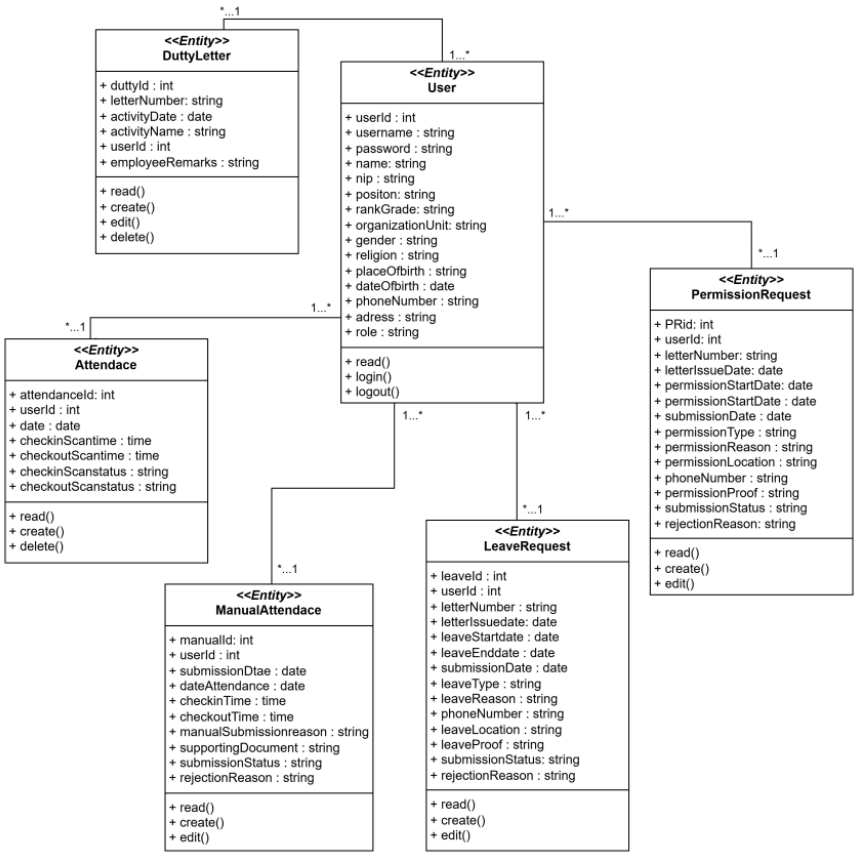


Figure 4. Class diagram of the fingerprint attendance information system.

3.7. Result of Physical Design

The physical design phase focused on translating the logical models into technical specifications that are ready for implementation. This process began with the identification of hardware and software requirements to ensure optimal performance and compatibility. The software stack selected includes a web framework that supports real-time data access, secure authentication, and responsive interfaces, while the hardware specifications were adjusted to support biometric fingerprint devices, stable network connectivity, and data storage reliability. In addition, a prototyping approach was used to create an initial version of the user interface, which was presented to stakeholders for validation. One of the initial interface designs is shown in the following Figure 5.

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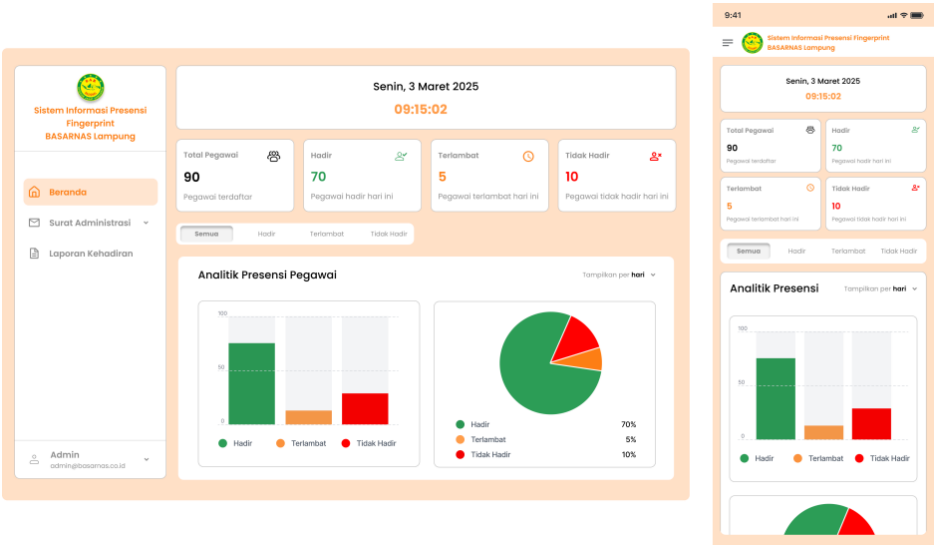


Figure 5. Admin dashboard prototype of the fingerprint attendance system.

The physical design phase involved the specification of both hardware and software components required to support the implementation of the web-based fingerprint attendance information system. The software architecture was built using the Laravel framework (version 9 or 10) with PHP 8.x as the backend language and MySQL/MariaDB as the database management system. Additional tools such as ZKLibrary (for data retrieval from ZKTeco devices), Apache or Nginx as the web server, and Composer with Git for dependency and version control were also included to support system operations and maintenance.

On the hardware side, the system was designed to work with ZKTeco MB2000 fingerprint devices equipped with face, fingerprint, and PIN input capabilities, connected via TCP/IP or USB. A stable local network using routers or switches (minimum 100 Mbps) and CAT5e/CAT6 LAN cables ensures device connectivity. The server specification includes at least a Core i5 processor, 8GB RAM, and a 256GB SSD to run the Laravel application and database effectively. Admin or client devices can use standard PCs to access the web interface, while a UPS is recommended to provide backup power during outages. An internet modem may be added for optional remote access. These hardware and software specifications serve as the technical foundation for ensuring the reliability, scalability, and security of the system in real-world operational environments.

4. CONCLUSIONS

Based on the research conducted on the fingerprint attendance information system at BASARNAS Lampung using the Structured Systems Analysis and Design Method (SSADM), it can be concluded that the existing system has not yet achieved optimal efficiency in managing employee attendance data. Although fingerprint devices are used to record attendance, the data processing is still carried out manually using spreadsheet applications such as Microsoft Excel. This results in slow data recapitulation, a higher risk of recording errors, and difficulties in generating reports such as leave permits and duty assignment letters (SPT).

Through the SSADM stages, a clearer and more structured understanding of the new system requirements was obtained. The feasibility study confirmed that a web-based attendance system is technically viable with the existing infrastructure, operationally user-friendly, and economically beneficial in the long term. The analysis of the current system emphasized the urgency of developing an integrated system capable of automatically storing, managing, and presenting attendance data.

The proposed system design includes both logical and physical models aligned with user needs. Class diagrams and entity-relationship diagrams (ERDs) represent data structures and process flows clearly. Additionally, the user interface design focuses on ease of use, with menus that support key functions such as data input, attendance recaps, and report generation. As a web-based system, it supports access from multiple devices through local or internet networks, offering flexibility in data management.

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Overall, the results of this analysis and design process demonstrate that the proposed system offers a viable solution to improve the efficiency, accuracy, and effectiveness of attendance administration at BASARNAS Lampung. This system design can serve as a foundation for further development, implementation, and testing in future stages. Nevertheless, challenges such as user training and integration with existing infrastructure must be carefully addressed during the implementation phase.

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